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GPS Guided Munitions and Precision Engagement: Do National and Theater Targeting Agencies Fully Support the Joint Forces Commander?

by

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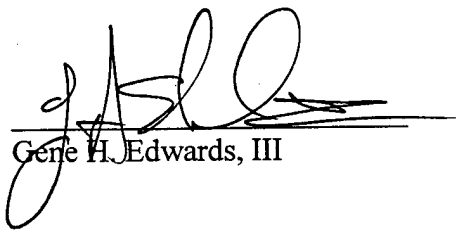
A paper submitted to the Faculty of the Naval War College in partial satisfaction of the requirements of the Department of Joint Military Operations.

The contents of this paper reflect my own personal views and are not necessarily endorsed by the Naval War College or the Department of the Navy.



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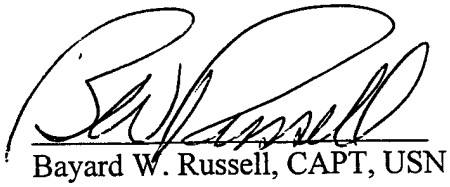

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15.Abstract: The introduction of GPS guided munitions (GGMs), including JDAM and JSOW, promises to have a profound, force-multiplying impact on the Joint Force Commander's (JFC) ability to deliver "precision" operational fires. The JFC's use of these new weapons however, will present several challenges which must be solved prior to wide scale GGM deployment. The all-weather, standoff characteristics of GGMs dictate a change in weapons employment accountability. Additionally, the accurate, mensurated target coordinates on which GGMs rely will require the JFC to forge a more robust relationship with supporting theater and national agencies. This paper examines the impact that the deployment of GGMs will have on the JFC, analyses the recent "Silent Fury" C4ISR experiment, and makes recommendations to improve organizational processes prior to wide scale GGM initial operational capability.

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ABSTRACT

The introduction of GPS guided munitions (GGMs), including JDAM and JSOW, promises to have a profound, force-multiplying impact on the Joint Force Commander's (JFC) ability to deliver "precision" operational fires. The JFC's use of these new weapons however, will present several challenges which must be solved prior to wide scale GGM deployment. The all-weather, standoff characteristics of GGMs dictate a change in weapons employment accountability. Additionally, the accurate, mensurated target coordinates on which GGMs rely will require the JFC to forge a more robust relationship with supporting theater and national agencies. This paper examines the impact that the deployment of GGMs will have on the JFC, analyses the recent "Silent Fury" C4ISR experiment, and makes recommendations to improve organizational processes prior to wide scale GGM initial operational capability.

THESIS

Joint Vision 2010 (JV 2010) predicts that "Long-range precision capability, combined with a wide range of delivery systems, is emerging as a key factor in future warfare".[1] To achieve this, one must have all-weather, precision weapons and timely, accurate targeting information. The first part of this emerging capability is now available to the Joint Force Commander (JFC) in the form of Global Positioning System (GPS) guided munitions--GGMs.

The wide scale deployment of these new GGMs will enable the operational commander to rapidly, accurately, and simultaneously strike throughout an enemy's operational depth. Additionally, GGMs allow the JFC to strike in virtually any weather, day or night, thus ensuring freedom of action.

Already deployed in limited numbers, the precise planning needed by these weapons cannot be done without the targeting support of national and theater agencies.[2] This extensive use of third-party targeting information will change traditional notions concerning weapons employment accountability. Additionally, the external support required for GGM employment places new demands on the JFC by directly impacting the Air Tasking Order (ATO) production of his principle striking element, the Joint Force Air Component Commander (JFACC).

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[1] Joint Chiefs of Staff, Joint Vision 2010, (Washington, D.C.: July, 1996), 11.
[2] Lynne Puetz, National Imagery and Mapping Agency, telephone conversation with author, 8 December 1997.

Without the seamless transfer of timely and, most importantly, accurately mensurated coordinates from these supporting agencies, the Joint Force Commander (JFC) may be forced to restrict the employment of this force-multiplying technology. If we are to leverage the unique capabilities that GGMs offer, we must act now to optimize the support infrastructure and organizational relationships between the JFC and these critical supporting agencies.

This paper examines the impact that the deployment of GGMs will have on the JFC, analyses recent experiments, and makes recommendations to improve organizational processes prior to wide scale GGM initial operational capability (IOC).

THE IMPACT OF GGMs ON THE OPERATIONAL COMMANDER

The U.S. is placing a great deal of emphasis on the emergence of various GGMs to offset declining force levels.[3] Additionally, we are counting on these GGMs to "...engage targets more responsively and accurately from increasingly longer ranges..." while "...minimizing collateral damage through precise targeting and accurate, effective delivery systems and munitions."[4]

This ability of GGMs to act as a force multiplier was recently demonstrated by U.S.S. Nimitz/CVW-9 during PAC JTFEX 97-2. Nimitz and her air wing surged to generate 200 strike sorties per day for 96 hours.[5] Armed with a notional four GGMs per strike fighter, and

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[3] John D. Morrocco, "PGM Strategy Faces Budget, Technical Traps," Aviation Week, 27 February 1995, 44.
[4] Joint Chiefs of Staff, Concept for Future Joint Operations, (Washington, D.C.: May 1997), 52.
[5] Naval War College, Fleet Battle Experiment Bravo Quicklook Report, (Newport, R.I.,: September 22, 1997), 4.

the ability to pair one GGM to each aimpoint, the "Speed and depth of initial target prosecution enabled planners to forgo the traditional "roll back" prosecution of the target sets...."[6] Thus, a single air wing (or Air Expeditionary Force), armed with GGMs, could quickly place an entire target set or an enemy's center of gravity at risk.[7]

The substitution of GGMs for conventional ordnance will greatly improve the JFC's air component's ability to conduct operational and tactical fires. The inherent accuracy of GGMs, combined with fewer target obscuration concerns, will result in less re-strikes following unsuccessful or weather aborted missions. The standoff capability of some GGMs will reduce the need for dedicated SEAD, thus freeing up more strike aircraft and simplifying route planning.[8] Finally, the ability to accurately employ GGMs from high altitude will increase aircraft strike range while negating most terminal threats--delivering fires deeper and faster with less risk.

One such air-launched GGM, the Joint Standoff Weapon (JSOW), is currently deployed to the Arabian Gulf and another, the Joint Direct Attack Munition (JDAM), is scheduled to reach IOC in 1999.[9]

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[6] Naval War College, 5.
[7] LCDR Steve Clarke, Third Fleet Readiness Officer, telephone conversation with author, 31 December 1997.
[8] Naval War College, 2.
[9] CDR Mike Scavone, Cruise Missile Support Activity Atlantic, telephone conversation with author, 15 December 1997.

Current Department of Defense (DoD) plans call for the procurement of over 23,000 JSOW glide bombs and up to 74,000 JDAM kits.[10]

Deployment of these and other GGMs, including the ship-fired Extended Range Guided Munition (ERGM), will provide commanders the here-to-for unknown capability to deliver accurate, all weather fires--if one knows exactly where the target is located. As stated by Major General George Muellner, head of the Pentagon's Joint Advanced Technology Program, target location error (TLE), "how accurately you know where a target is in GPS space...is not a trivial issue."[11]

GGMs AND JOINT FIRES: THE NEED FOR COORDINATE ACCURACY

Accurate to within 13 meters, and thus a great improvement over conventional unguided ordnance, JSOW and JDAM are not technically considered "precision" weapons as are laser guided bombs.[12] Lacking either a terminal seeker or man-in-the-loop (MITL) guidance, GGMs rely exclusively on GPS guidance and the precise target coordinates provided prior to launch. This "launch and leave" employment, while providing both increased standoff and flexibility, places a premium on preflight planning as the weapon will fly to the desired point of impact (DPI) programmed at release. It has been noted that, due to the ability of MITL guidance to

[10] General Accounting Office, Precision Guided Munitions in Inventory, Production, and Development, Report to Congressional Committees (Washington: 1995), 13.
[11] Morrocco, 46.
[12] "United States, Missiles/Rockets/Land Attack/Theater," 2 September 1996, U.S. Naval Institute Military Database, Rockville, MD: United Communications Group, October 1997.

correct for targeting errors, "...ironically, 'precision' weapons require less accurate targeting coordinates than GGMs."[13]

This need for accuracy is not only driven by the unique guidance characteristics of GGMs but also by their method of employment. JSOW is an all weather, sub-munition dispensing standoff weapon with a range of over 40 nautical miles (nm)--outside the range of aircraft sensors which would enable positive target identification.[14] JDAM, a GPS guided, MK-80 series 1,000 or 2,000 pound bomb, is designed to be dropped through the weather--again prohibiting positive target identification by the launching aircraft. This target identification problem is not restricted to the JFC's air component; ship captains or artillery batteries attempting "precision" fires with the 60nm ERGM will encounter similar Rules of Engagement (ROE) challenges.

GGMs AND ROE: WHO IS ACCOUNTABLE?

The employment characteristics of GGMs dictate a paradigm shift concerning accountability. Traditionally, with the exception of TLAM, firing units, and aircrew in particular, have been held responsible for where their weapons fall. One impact of this mindset has been the development of de-centralized mission planning. While this planning would normally include specific aimpoint selection, "For the foreseeable future, it is unlikely that aircrews

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[13] Center for Naval Analysis, Fleet Battle Experiment Bravo-Silent Fury Analysis Report (Sponsor Review Version), CRM 97-124.09 (Alexandria, VA: 1997), 22.

[14] "United States, Missiles/Rockets/Land Attack/Theater," 2 September 1996, U.S. Naval Institute Military Database, Rockville, MD: United Communications Group, October 1997.

will themselves be able to mensurate GGM target coordinates."[15] This constraint is not confined to the JFC's air component; it will impact all who seek to use this new technology.

The use of GGMs will require reliance on a more centralized method of target coordinate production (possibly increasing the size of the JFC staff), with the firing unit responsible for verifying coordinate accuracy prior to weapons release. With GGMs however, the delivery platform (be it aircraft or ship) might only be able to coarsely verify that the "actual" target position matches the pre-programmed coordinates.

For example, even if one compares target aimpoint coordinates with available charts or imagery to ensure that some gross error has not occurred, one still might not be able to verify that those coordinates coincide with the intended target and not with a school located across the street. Correct elevation data is also critical to ensure that the weapon does not fall short or long of its intended aimpoint. Unfortunately, few, if any, charts or imagery contain the detailed elevation information necessary to confirm GGM target coordinates. That imagery which *is* acceptable is time consuming to transmit and will surely stress the JFC's available communications channels.

While pre-planned aimpoint verification presents many challenges, the use of demonstrated capabilities such as "real time"

[15] Center for Naval Analysis, 129.

third-party targeting will test the limits of current weapons employment doctrine. The ability of a JFC to rapidly re-task aircraft (or weapons) in flight may deny "shooters" the time needed to attempt target data confirmation.

Thus, as is done with cruise missile employment, we need to shift targeting accountability from the firing unit to the mission planner. A GGM firing unit should be held responsible for achieving the proper launch parameters, ensuring proper weapon functioning prior to release, and for attempting to verify target location within the constraints of available sensors.[16] Since there is currently no means of "sweetening" the shot using MITL guidance or of diverting the weapon after launch, it is essential that the coordinates provided to the weapon, both horizontal (latitude and longitude) and vertical (elevation), are of the highest accuracy--and those who produce those coordinates be held accountable.

GGMs AND MENSURATION

How are these precise GGM coordinates obtained? The process of correlating a point on an image with a geo-centric coordinate is called mensuration.[17] As a product of the targeting cycle's weaponeering phase, specific target element aimpoints are generated and annotated on imagery (now called annotated aimpoints). For those targets selected for cruise missile, *and now GGM attack*, the annotated imagery is passed on for mensuration, and, in the case of

[16] Ibid, 130.
[17] Ibid, 7.

TLAM, mission planning. During mensuration, both the horizontal location (lat/long) and the vertical location (elevation) of the annotated aimpoint are determined. After mensuration, the aimpoint with its geo-coordinate is now referred to as a DPI.

One other essential product of the mensuration process is target location error (TLE). The mensurating agency must provide an estimate of TLE with each DPI so that the "consumer" has an indication of coordinate accuracy. Different GGMs have significantly different coordinate accuracy requirements, thus the degree of TLE may affect weapon-target pairing.[18]

To achieve the accuracy required for GGM employment, trained personnel using sophisticated equipment such as the Digital Imagery Workstation Suite (DIWS) (or equivalent) are required. Currently, the only deployed mensuration capability available to the JFC is the Cruise Missile Support Activities' (CMSA) Afloat Planning System (APS) detachment. Though manned for two DWIS workstations, the APS detachment's primary focus is on TLAM planning. Thus, though able to support limited contingency operations planning, any large scale use of GGMs will require the robust mensuration capability found only at the two CMSAs (four workstations each) and at the National Imagery and Mapping Agency (NIMA) (with 15 workstations).[19]

Unless significant, detailed, DPI planning has taken place

[18] CDR Mike Scavone, Cruise Missile Support Activity Atlantic, telephone conversation with author, 15 December 1997.
[19] Center for Naval Analysis, 52.

prior to a conflict, the JFC will require continuous connectivity with these dispersed and, except for the CMSAs, uncoordinated mensurating agencies in order to effectively employ GGMs. These coordinates must also be delivered to meet the needs of the JFACC's Air Tasking Order (ATO) cycle.

GGM TARGETING AND THE JFC

How does this new mensuration requirement impact the JFC? First, a significant portion of the JFC's GGM precision fires will be delivered by aircraft, thus we must be able to indigenously or externally generate mensurated coordinates within the JFACC's 48 hour ATO planning cycle.

Second, off-site mensuration requirements for GGMs dictate that the JFACC become the central coordination authority for all GGM employment. During the ATO planning cycle, the presence of collateral damage concerns, poor weather, or the need to ensure destruction of a particular target may dictate a GGM-target pairing. If "GGM quality" DPIs are available on locally held imagery or databases, and the TLE is known, a specific weapon-aimpoint pairing is possible and should be included on the ATO.

If GGM DPIs are not available, annotated aimpoints must be given to the APS detachment or "brokered" to a supporting agency for mensuration. If these coordinates are not returned to the JFACC before the ATO "goes to press", the JFACC must either drop the

target until the next scheduled ATO or assign a different weapon or platform.

Changing the weapon/platform assigned could have a significant impact on the ATO and the speed at which JFC can prosecute enemy target sets. Assigning the use of conventional "dumb" bombs may require accepting a much higher risk of collateral damage and will certainly increase the number of strike and support aircraft required to attack the target. For those targets where a PGM (or TLAM) is substituted, a valuable precision weapon will be expended--and unavailable for later ATOs.

Unfortunately, recent fleet experiments indicate that the accelerated deployment of these GGMs may overtake the JFC's capability to provide the precise, mensurated coordinates that these weapons require--a case of putting the "cart before the horse".[20]

SILENT FURY: A WAKE UP CALL FOR THE JFC?

"Silent Fury", the first such attempt to investigate the impact of GGMs on the JTF targeting process and supporting C4ISR architecture, was conducted 28 August to 22 September, 1997, as part of Fleet Battle Experiment Bravo (FBE-B). This three phase experiment "...examined the accuracy, volume, and timeliness of aimpoint production using national, theater, and tactical assets in support of a sea-based CJTF and JFACC," thus hoping to "...identify choke points which might impede effective use of GGM weapons."[21]

[20] Naval War College, 6.
[21] Ibid, 4.

The results, though mixed, are encouraging--if we act now to prepare for the future.

In Phase I, Silent Fury tasked NIMA, CMSA Lant, CMSA Pac, and APSPAC Det Two with mensurating 15 pre-surveyed points to verify accuracy. While all agencies met 100% of the less stringent JSOW TLE required for weapons employment, only 67% met the stricter JDAM TLE--a 33% error.[22] This albeit limited sample indicates that the accuracy predictions provided by these agencies may be optimistic and thereby affect the JFC's weapon-target pairing where collateral damage is a consideration. Such errors also bring into question the promise of "one weapon per aimpoint" employment.

On a more positive note, however, afloat aimpoint accuracy and production rate per workstation equaled that of the CONUS based support agencies.[23] If the necessary target materials are deployed with the JFC, this in-theater capability may support ATO production without continuous JFC-CONUS communications connectivity. While space limitations may restrict the number of workstations and trained personnel deployed with the afloat CJTF/JFACC, this would not be a big restriction once deployed ashore.

During Phase II, the agencies were tasked to support strikes against an OPLAN 5027 target set. While 399 targets were "brokered" over three days to produce 1659 DPIs, most points were held within NIMA's Digital Point Positioning Data Base (DPPDB), thus enabling

[22] Center for Naval Analysis, 7.
[23] Naval War College, 5.

rapid DPI production.[24] In a less mature theater, where DPPDB coverage is not as extensive (as is the case in most of the world), DPI production would be significantly slower.[25]

Additionally, the 339 targets were not weaponeered prior to mensuration. Effective GGM employment requires that each target be weaponeered for a specific weapon (such as MK-83 or MK-84 JDAM) to produce an aimpoint (which must then be mensurated). NIMA, though possessing the most robust mensuration capability, has no weaponeers on staff and is thus completely reliant on the JFACC to show them "what point to measure".

One potential source of weaponeering expertise available to the JFACC is present in the deployed APS detachment. Though their primary focus is on TLAM planning, any "excess" capacity could be made available for both weaponeering and mensuration. At present however, APS personnel are qualified to weaponeer TLAM only and are thus unavailable to assist in JDAM or JSOW targeting.[26]

During Phase III, Silent Fury investigated the impact that GGM employment would have on the JFACC's ATO planning cycle. A 109 target Joint Integrated Priority Target List (JIPTL), divided among three ATOs, was brokered to the different mensurating agencies via C3F's home page. 85% of the DPIs produced were returned in time to

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[24] Center for Naval Analysis, 9.
[25] CDR Mike Scavone, Cruise Missile Support Activity Atlantic, telephone conversation with author, 18 December 1997.
[26] LCDR Eric DeVita, Cruise Missile Support Activity Pacific, telephone conversation with author, 30 December 1997.

make the day's ATO.[27] The 15% "failure" rate can be traced to various factors.

First, the JIPTL for this phase was drawn from an OPLAN in a theater less well covered by DPPDB than in Phase II. The lack of DPPDB limited the size of the geographic area which could be loaded for mensuration, thus slowing DPI production. For example, CMSALANT mensurated approximately 600 aimpoints per 24 hours of effort when working targets which reside within the DPPDB while only 100 for those which did not.[28]

Second, not all the agencies had access to the same imagery as there is currently no central imagery database--some time was spent during the brokering process determining who could work certain targets. Third, some aimpoints were passed from the JFACC to the agencies via a textual description of the intended aimpoint--not annotated imagery. This required the various mensurating units to "guess" which point actually needed to be measured. That said, the results of Phase III indicate that these agencies can indeed mensurate GGM DPIs within the 48 hour ATO cycle--provided that adequate imagery is available.

One disturbing finding during Phase III--14% of the target coordinates published in ATO were incorrect due to transcription errors. These errors may have significant ROE implications for the

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[27] Center for Naval Analysis, 11.
[28] CDR Mike Scavone, Cruise Missile Support Activity Atlantic, telephone conversation with author, 18 December 1997.

JFC. When one considers the coordinate verification challenges already inherent in GGM employment, "It is very important that DPIs that appear in the ATO be absolutely correct because they cannot be checked before being entered into the weapon."[29] Unless procedures are streamlined and, most importantly, standardized, simple "typos" could have devastating consequences.

RECOMMENDATIONS

Addressing the accuracy, volume, and timeliness challenges highlighted by Silent Fury is but the first step toward reaching the war fighting potential that GGMs offer. GGMs are "joint" weapons which require extensive support from national agencies--thus these challenges will demand "joint" solutions.

First, Joint Staff J2 (Targets) [J2T] must order further testing, using a large and diverse target set, to determine the coordinate accuracy which can be consistently delivered to the JFC. If the required JDAM TLE cannot be achieved 100% of the time then the JFC will need to account for this by weaponeering (allocating more or larger JDAMs) or, if collateral damage is a factor, by choosing a PGM instead.

Second, to reduce the number of target aimpoints which must be weaponeered and mensurated during a crisis, each Combatant Command's Joint Intelligence Center needs to undertake a coordinated, theater-level GGM planning effort. As stated in the Silent Fury Analysis

[29] Center for Naval Analysis, 12.

Report, "Each theater should establish and maintain a common database of targets, target imagery, and aimpoints mensurated (along with supporting rationale)."[30] Though centrally maintained by the CINC, this database should be deployed with any unit which could conceivably support JFC operations.

One logical focal point for this effort is the existing OPLANS and CONPLANS. Target elements should be weaponeered for GGMs and those aimpoints subsequently mensurated. Over 7000 TLAM missions are planned and all their aimpoint coordinates are already within the most restrictive GGM's acceptable TLE.[31] Certainly, the weaponeering process will reveal that not all TLAM aimpoints would be appropriate for use with JDAM or JSOW, however, many will--thus expanding the JFC's operational fires options.

Another, yet untapped source of GGM targeting information could come from the CMSA APS detachments. On a recent deployment, APS personnel spent 2/3 of their time supporting the carrier air wing's strike planning needs. Unfortunately, any aimpoints mensurated during a deployment usually remain buried in CVIC strike planning folders and never leave the ship.[32] These points should be submitted to the appropriate Joint Intelligence Center (JIC) for inclusion into the theater database. Additionally, because some

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[30] Ibid.
[31] CDR Mike Scavone, Cruise Missile Support Activity Atlantic, telephone conversation with author, 18 December 1997.
[32] LCDR Eric DeVita, Cruise Missile Support Activity Pacific, telephone conversation with author, 30 December 1997.

units may deploy, and thus work targets, in more than one geographic AOR, there needs to be a standardized method for submitting and retrieving target data from the various databases. NIMA or J2T should maintain a central, on line, index of all targets held in the CINC databases.

Silent Fury demonstrated that on and off-site agencies could support GGM targeting requirements within the JFACC's 48 hour ATO planning cycle. This support was, however, ad hoc and somewhat uncoordinated. Several organizational and doctrinal deficiencies must be corrected if we are to seamlessly integrate these weapons into the JFC's "bag of tricks".

First, weaponeers (including those in the APS detachments) need to have standardized training concerning the intricacies of GGM employment. This could be conducted by the CINCs, but a national "joint" GGM school would more effectively standardize doctrine and procedures among those who might be "thrust" together to support a JFC.

Second, annotated imagery is essential to speed the targeting effort--and prevent errors. Currently, various commercial off-the-shelf annotation tools, some incompatible with each other, are used by the different targeting cycle participants. Ideally, NIMA should dictate specific annotation software standards and, when annotated imagery cannot be passed due to poor communications connectivity, a standard textual request format (to include the specific WORD or

EXCEL version if necessary). Until such national standards are established, a CJTF must ensure that a common format is addressed in every OPORD.

Third, the vagaries of GGM planning dictate a degree of centralized GGM weaponeering at the JFC level. The JFC will then, if the coordinates cannot be produced locally, "broker" his annotated aimpoints to NIMA or the CMSAs. If necessary, the weaponeering process could be brokered to a remote location as well. This brokering process works--and will work more efficiently, once a formal SOP is agreed to between the CINCs and the mensurating agencies. The brokering process must, however, address both accountability and accuracy. As target coordinates are entered into the theater databases, we must ensure that those who might use them, perhaps months or years in the future, know both the source of the data and the TLE associated with those coordinates.

Fourth, one critical deficiency that must be corrected concerns the presence of ATO transcription errors. Assuming that we have, through the use of annotated imagery, ensured that the intended aimpoint has been mensurated, we must now find a way to limit the number of personnel who physically "touch" these coordinates after mensuration. Whatever method used, it should also support a final "quality assurance" check by the launching platform prior to weapon release.

Finally, the questions brought about by GGM deployment and experiments such as Silent Fury beg the question: do we need a central GGM planning facility?

According to many, the formation of a Joint Precision Guided Munitions Support Activity (JPGMSA), modeled on, or part of, the CMSAs, would solve many of the problems identified by Silent Fury.[33] The creation of this jointly staffed facility would streamline the weaponeering and mensurating process while simultaneously standardizing training and procedures. Using the quality assurance procedures already resident in the TLAM planning process, this "single source" of PGM/GGM target materials would improve throughput and reliability. A central, CONUS based facility would also reduce the logistics footprint necessary to support a forward deployed JFC and JFACC.[34]

While various CMSA, JIC, and J2T representatives support the centralization of the PGM/GGM planning effort, several questions remain. Will a central facility be responsive? Who will set priorities if engaged in a "two major theater of war" scenario? Though efforts are underway to improve communications connectivity between units, numerous SHF outages were encountered during Silent

[33] LT COL. Mark Christian, USAF, Joint Intellegence Center Pacific, telephone conversation with author, 21 January 1998.
[34] CAPT. Steve Frey, USAF, Cruise Missile Support Activity Pacific, telephone conversation with author, 12 December 1997.

Fury. If we commit ourselves to centralized support, how will we ensure connectivity when under C2W attack by a determined foe?

CONCLUSION

Today, with the introduction of GPS guided munitions, the JFC is just beginning to realize the "precision" fires capability embodied in JV 2010. This technology, while promising an increased operational and tactical fires capability, comes with a cost--the operational commander will be expected to do more--with less. GGMs demand a new, seamless, and, so far, undeveloped support architecture. If we do not act now to address these challenges, we may find that the demands of GGM employment, particularly in regards to ROE, will restrict the JFC's freedom of action instead of expanding it.

Though technological solutions, such as increased communications bandwidth and video teleconferencing, may improve data "push" and "pull" between the JFC and supporting agencies, only organizational restructuring and doctrinal change will ensure a seamless flow of timely, accurate coordinates to the war fighter. We are told that "Remote connectivity will allow many staff functions to be accomplished in a single, fixed location, even as the commander moves throughout the battlespace."[35] At the same time, however, we are also cautioned that, though technology may enhance the *potential* of a force, it is "...improved

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[35] Joint Chiefs of Staff, Concept for Future Joint Operations, 68.

doctrine,...innovative leadership,...and adaptable organizational structures..."[36] that will actually achieve this revolutionary capability. The future is just around the corner--and it is coming whether the JFC is ready or not.

[36] Ibid, 33.

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